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FOR

A VALVE FOR CLOSING A GAS COMBUSTION CHAMBER

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A VALVE FOR CLOSING A GAS COMBUSTION CHAMBER

The invention relates to safety valves for combustion or post-combustion chambers, in particular for installations for vitrifying or heat-treating waste, such as asbestos waste.

A known safety valve for a combustion chamber orifice comprises a shutter mounted to pivot relative to the chamber about an axis that is contiguous with the orifice and parallel to the general plane thereof. The valve has means for opening and closing the orifice on command. It also has a counterweight device that compensates the weight of the shutter and enables it to be opened automatically in the event of gas pressure in the chamber becoming excessive. Nevertheless, that shutter presents numerous drawbacks. Firstly, in the open position, the various portions of the shutter are not uniformly subjected to the outgoing flow of gas, so if it is open for a long period, its portions deform differently from one another under the effect of the heat, and this takes place irreversibly. Specifically, the hinge is particularly weakened by prolonged open periods. In addition, while the valve is being opened, the flow section is not uniform and it is necessary for the shutter to move through a large angle in order to clear the entire section for gas flow. This large angle leads to a sudden movement or "missile effect" in the event of unintentional opening due to excess pressure, and that can be harmful to the valve and to the chamber. In addition, it is difficult to dissipate or to recover and store the kinetic energy produced by moving the shutter during opening.

An object of the invention is to provide a valve that remedies those drawbacks.

In order to achieve this object, the invention provides a safety valve for a chamber, the valve comprising a frame, a shutter, controlled drive means to cause the shutter to open and close an orifice of the

chamber, and also release means for causing the shutter to open automatically when pressure in the chamber reaches a predetermined threshold, wherein the shutter is mounted to slide relative to the frame.

Thus, by sliding the shutter, its various portions, or at least those portions which are situated at the same distance from the center of the shutter, are subjected overall to the same gas flow on opening. As a result, these portions deform uniformly. Even if deformation is irreversible, it does not compromise the lifetime of the shutter. In addition, the means connecting the shutter to the frame can be placed so they are not exposed directly to the flow of gas, thereby preserving them. Furthermore, a large flow section is obtained as soon as opening begins. Gas at excess pressure is thus released very quickly on opening. There is no risk of the "missile effect". In addition, the kinetic produced by sliding is easily dissipated or stored.

Advantageously, the shutter is mounted to slide in the vertical direction.

Advantageously, the orifice has a vertical axis, the valve including a sealing gasket fixed to the frame and suitable for coming into contact with the shutter.

Thus, when the orifice is at the top of the chamber, and on opening, the gas escapes along the edges of the shutter and not along the gasket. The gasket is thus also sheltered from radiation from the chamber. The gasket is thus protected and its lifetime extended.

Advantageously, the gasket is annular in shape and of a diameter greater than the largest diameter of the orifice.

Thus, the sliding shutter makes it possible to place the gasket at a distance from the orifice so as to protect it as much as possible from the flow of gas, and makes it possible for the gasket to be of considerable length so as to obtain a better distribution of loading during closure.

Advantageously, the frame comprises a cage suitable for preventing any movement of the shutter beyond the cage away from the orifice.

This improves the safety of the installation.

Advantageously, the valve is arranged in such a manner that the shutter is suitable for occupying an open position in which it comes into abutment against the cage.

Advantageously, the drive means comprise at least one spring for causing the shutter to perform one action out of closing and opening, and preferably opening.

Advantageously, the drive means comprise an actuator for causing the shutter to perform one out of opening and closing, and preferably closing.

The preferred technique of opening by means of springs imparts positive safety to the valve in that an unexpected loss of power for driving the actuator does not prevent the valve from opening.

Advantageously, the release means comprise means for permanently compensating the weight of the shutter, at least in part.

Advantageously, the compensation means comprise at least one spring.

Compared with a counterweight system, such compensation means have the advantage of not increasing the inertia of the assembly excessively, thus making it easier to open quickly in the event of excess pressure.

Advantageously, the valve comprises means for adjusting the pressure threshold.

The valve can thus be better adapted to the pressure conditions inside the chamber for better safety.

The invention also provides a chamber, in particular for combustion or post-combustion in an installation for treating solid asbestos waste, and including a valve of the invention.

Other characteristics and advantages of the invention appear further from the following description

of a preferred embodiment given by way of non-limiting example. In the accompanying drawings:

· Figure 1 is a partially cutaway plan view of the valve;

· Figure 2 is an elevation view of the valve in the closed position;

· Figure 3 is an axial section view of the valve in the closed position;

· Figure 4 is a view on a larger scale showing a detail of Figure 3;

· Figure 5 is a view analogous to Figure 3 showing the valve in its controlled open position;

· Figure 6 is a view analogous to Figure 3 showing the valve in its position when opened by excess pressure; and

· Figure 7 is a diagram of the dynamics of the valve.

The valve 2 described below is associated with a gas combustion or post-combustion chamber 4 in an installation for heat-treating solid waste such as asbestos waste that is to be made inert. The valve is placed at the top end of a chimney 6 of the chamber, which chimney has a cylindrical wall about a vertical axis 8 and is made of refractory material.

The valve includes a frame 10. The frame comprises a horizontal baseplate 12 fixed to the chimney perpendicularly to the axis 8, and an intermediate bridge 14 parallel to the plate and fixed thereto by means of four bottom legs 16 disposed peripherally relative to an orifice 18 of the chimney. The frame 10 also comprises a horizontal top bridge 22 or plate fixed on the intermediate bridge 14 by means of four top legs 24.

The orifice 18 presents a shoulder in the inside face of the wall 6, the shoulder forming an annular horizontal plane face 26 and an outwardly flared face 28 leading to the baseplate 12.

The valve has a shutter 30 comprising a top support 32, e.g. made of a steel referenced A42cp, having a horizontal bottom wall in the form of a disk and a frustoconical side wall that flares outwardly and upwardly from the edges of the bottom wall. The shutter 30 has a bottom layer 34 of high temperature lagging material such as Kerlane. This layer 34 has the same shape as the support 32 but is smaller and solid. The layer 34 is fixed to the bottom face of the support 32. This layer is surrounded by a wall of refractory stainless steel. When the shutter 30 closes the orifice 18, the insulating layer 34 extends in register with the faces 26 and 28 of the orifice, and at a distance therefrom.

A shaft 36 extends coaxially with the shutter 30 from a top face on the support 32 and is fixed thereto. The shaft 36 is cylindrical and hollow. It is received in a duct 38 of the intermediate bridge 14 to be guided in sliding relative to the frame 10 along the axis 8.

The shutter has three balancing shafts 40 on vertical axes parallel to the axis 8 and fixed to the top face of the shutter 30 via ball-and-socket joints 41. The three shafts 40 are all at the same distance from the axis 8, and they are regularly distributed around it. The three shafts 40 are slidably movable relative to the frame 10, being received in balancing ducts 42 in the intermediate bridge 14. An adjustment screw 44 is received coaxially in each shaft 40 and forms a screw-and-nut connection with a thread inside the shaft. The screw 44 has its top head fixed to a cap 45 having a top horizontal wall and a cylindrical bottom wall with a portion thereof covering the outside face of the shaft 40. Each balancing shaft 40 is associated with a balancing spring 46. The compression spring bears downwards on the intermediate bridge 44 and upwards against the top wall of the cap 45, inside the cap. The spring 46 surrounds the shaft 40 being coaxial therewith.

In this case, each of the three balancing springs has stiffness of 0.4 decanewtons per millimeter (daN/mm). The springs are designed to compensate at all times at least a fraction of the weight of the shutter 30. Ideally, they should compensate this weight exactly so as to cancel the effect of gravity on the shutter 30 and regardless of whether the shutter is in its open or closed position. In practice, they compensate this weight to within 1% or 2%. The adjustment screw 44 can be adjusted to penetrate to a greater or lesser extent inside the shaft 40, thereby adjusting the balancing means.

The frame includes an actuator such as a pneumatic actuator 48 on the axis 8 and fixed to the top of the top bridge 22. This actuator has a piston rod 50 passing downwards through the top bridge 22 and extended coaxially by a drive shaft 52 or guide shaft, whose bottom end penetrates into the shaft 36. The piston rod 50 and the drive shaft 52 are connected to each other via a ball-and-socket joint. Two spaced-apart annular horizontal plane collars 54 are provided, with the higher collar being fixed rigidly to the drive shaft 52. They are also rigidly connected to each other by three spacers 56 distributed around the axis 8. The shaft 52 carries a top collar 66 rigidly fixed to the top collar 54. The collars 54 are plane and in the form of equilateral triangles.

The intermediate bridge 14 carries three vertical cylindrical cores 58 projecting from the top face of the bridge, regularly distributed around the axis 8 in alternation with the balancing shafts 40, and extending at the same distance from the axis 8 as the balancing shafts. A drive spring 60 is received externally on each core 58, coaxially therewith. The compression spring 60 bears downwards on the intermediate bridge 14 and upwards against a top wall of a drive cap 62 having a cylindrical wall covering the outside of the spring 60 and slidably

movable relative to the core 58 parallel to the axis 8. Each of the three drive caps 62 is rigidly fixed to the collars 54 and to a respective one of the spacers 56.

The shaft 36 passes through a central orifice of the bottom collar 54. It carries its own collar 64 extending between the two collars 54 and suitable for bearing against the top of the bottom collar 54.

The intermediate bridge 14 carries damping abutments 65 on its bottom face, the abutments being in the form of elastomer cones fixed in register with the actuator cores 58. The top face of the shutter 30 carries cylindrical pads 68, e.g. made of steel, in register with the abutments 65 and suitable for bearing against them when the shutter is in the open position.

With reference in particular to Figure 4, the shutter 30 has two cylindrical walls 70 centered on the axis 8, of diameters that are different but similar, and projecting downwards from the bottom face of the support 32. The baseplate has three cylindrical walls 72 about the axis 8, of diameters that are different but similar, and projecting upwards from the top face of the plate 12. Two beads 74 of braided high temperature sealing gasket are received between the walls 72. The walls 70 are arranged so that when the shutter is in the closed position, the two top walls 70 have their bottom edges bearing against the gaskets 74, with the five walls 70, 72 then facing one another and being spaced apart from one another.

The diameter of the smallest diameter wall 72 and the smallest diameter d of the inner gasket 74 are greater than the largest diameter of the orifice 18 as measured level with the plate 12. Thus, when the shutter 30 is in the open position, the gas escaping from the orifice 18 follows the path marked by arrows 76 without striking directly against the gaskets 74. In addition, these gaskets are not exposed directly to the radiation coming from the chamber. The walls 70 and 72 form two

baffles that co-operate with the gaskets 74 to provide good sealing. The gaskets 74 are of very large diameter. The load they carry in the closed position is therefore distributed over a large area of gasket, thereby prolonging their lifetime.

The operation of the valve is described below. The dynamics of the various parts can be seen more clearly from the simplified diagram of Figure 7. The valve comprises two main moving assemblies which are movable relative to the frame 10 and relative to each other: the shutter 30 and the balancing means 40, 46 constitute one assembly; and the drive apparatus 50, 54, 56, 62 and the actuator 48 form the other moving assembly.

Figure 5 shows the controlled open position of the shutter. The shutter is pressed against the intermediate bridge 14. The orifice 18 is cleared to allow gas to escape. The single-acting actuator 48 is deactivated. The shutter is supported by the balancing springs 46 as it is all the time. These springs are at their maximum length. The shutter is raised by the drive springs 60 which are likewise at their maximum length. The drive cap 62 and the drive shaft 52 are in their high positions. The bottom collar 64 rests against the bottom drive collar 54 and is thus likewise in its high position, as is the shutter 30.

To go from this controlled open position to the closed position, the actuator 48 is actuated. It then acts against the drive springs 60 to lower the shutter into the closed position, where it remains supported by the balancing springs 46. The actuator 48 is dimensioned to produce a force that is slightly greater than the resultant of the forces produced by the three drive springs 60. The shutter thus reaches the position shown in Figures 2 and 3. All of the springs 46 and 60 are now at minimum length. The actuator is maintained in the activated state for so long as it is desired that the orifice should remain closed. To open the orifice again

in controlled manner, it suffices to deactivate the actuator so that the shutter rises under drive from the drive springs 60.

The balancing screws 44 can be adjusted in such a manner that the balancing springs 46 provide forces having a resultant of magnitude very slightly less than the weight of the shutter and the parts secured thereto. Under these conditions, when abnormal pressure appears inside the chamber, this pressure tends to force the shutter into the unexpected open position, as shown in Figure 6. In this position, the shutter carried by the balancing springs 46 is in a non-controlled high position, with the balancing springs being at maximum length. The actuator 48 and the drive springs 60 are still in their positions that correspond to the shutter being closed. The collar 64 is moved away from the bottom drive collar 54 towards the top drive collar 54. When the excess pressure ceases, the shutter moves back down on its own to the closed position. The way the balancing screws 44 are adjusted makes it possible to determine the excess pressure threshold that causes the shutter to open automatically. This excess pressure threshold can be very low.

A small displacement of the shutter away from its closed position serves to provide a large flow section through which the gas can escape. The excess pressure these ceases to act on the shutter immediately after it has opened. It will be observed that the valve thus provides positive safety insofar as even when there is no power for driving the valve, safety is not compromised since the balancing springs 46 cause the valve to open in the event of excess pressure.

The intermediate bridge 14 is constituted in this case by four radial beams 72 bearing on respective legs 16 and fixed to two central circular plates 73: a top plate and a bottom plate. The frame thus forms a cage preventing the shutter from being projected out from the

cage. The cage can be designed to extend very close to the orifice 18 because of the sliding movement of the shutter 30.

It will be observed that in this embodiment, the balancing spring release means 40 are distinct and independent of the actuator drive means 48 and the spring 60. In addition, these two sets of means are each connected independently to the shutter, in parallel and not in series.

Means could be provided for detecting that the excess pressure limit threshold has been reached in the chamber and for deactivating the actuator 48 by switching off its control air inlet and connecting the actuator to exhaust.

The chamber can form part of an installation for destroying waste such as:

- asbestos;
- hospital waste;
- sewage station sludge;
- industrial sludge;
- clinker;
- fly ash;
- the residue from purifying smoke obtained by incinerating household waste;
- slag; and
- waste that is very slightly radioactive.